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MEMOIRS

OF THE

GEOLOGICAL SURVEY

OF

THE UNITED KINGDOM.

Figures and Descriptions

ILLUSTRATIVE OF

BRITISH ORGANIC REMAINS.

DECADE I.-VI

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N O T I C E.

PALÆONTOLOGICAL researches forming so essential a part of geological investigations, such as those now in progress by the Geological Survey of the United Kingdom, the accompanying plates and descriptions of British Fossils have been prepared as part of the Geological Memoirs. They constitute a needful portion of the publications of the Geological Survey, and are taken from specimens in the public collections, or lent to the Survey by those anxious to advance this branch of the public service. Although numerous drawings had previously been made, and engravings from them considerably advanced, it was not thought expedient to commence their publication until the large collections of the Survey could be well examined, which a want of the needful space has, until the present time, considerably retarded. This impediment to progress is now being removed, and when the collections can be properly displayed in the New Museum of Practical Geology, in Jermyn Street, it is hoped that the public will have an opportunity of gradually obtaining, in a convenient manner and at small cost, a work illustrating some of the more important forms of animal and vegetable life there preserved, and which have been entombed during the lapse of geological time in the area occupied by the British islands.

The plan proposed to be followed in the work, of which the two Decades now published form a part, is as follows:—

To figure in elaborate detail, as completely as possible, a selection of fossils, illustrative of the genera and more remarkable species of all

classes of animals and plants the remains of which are contained in British rocks ; to select especially such as require an amount of illustration which, to be carried out by private enterprise, would require a large outlay of money, with little prospect of a return, and a long time to accomplish, but which, by means of the staff and appliances necessarily employed on the Geological Survey, can be effected at small cost, and with a rapidity demanded by the publication of the maps and memoirs of the Survey ; thus, it is hoped, affording an aid to those engaged in the sciences with which this work is connected, that they might not otherwise have possessed, and which may materially promote the progress of individual research.

H. T. DE LA BECHE,
Director-General.

Geological Survey Office,
24th May, 1849.

BRITISH FOSSILS.

DECADE THE FIRST.

THE first Decade of representations of British Fossils is devoted to a selection of Echinoderms, of the Orders *Asteriadae* and *Echinidae*.

With the exception of the *Crinoidea* and *Cystidea*, no special monographs have been devoted to the illustration of our fossil species of Echinodermata, notwithstanding their acknowledged importance in a geological point of view. The majority of species found in British strata are unfigured in British works; a very great number are not figured at all, and those of which we possess British figures are, for the most part, delineated either imperfectly or insufficiently for the demands of science in its present state. This is the more remarkable since, for the description and delineation of numerous species, ample materials exist in collections.

Of the following plates, one is devoted to figures of all the Silurian star-fishes as yet discovered in British strata. None of these have hitherto been represented in any work. Their names only, accompanied by short descriptive characters, have appeared in the "Synopsis of British Fossil Asteriadae," contained in the second part of the second volume of the "Memoirs of the Geological Survey of Great Britain." Some remarkable new forms of star-fishes from the Oolites, and all as yet discovered in the London clay, are figured in the second and third plates.

The fourth plate is devoted to a representation of the only fossil as yet discovered of the family *Euryales*, now for the first time described and figured, through the kind co-operation of the Rev. Professor Sedgwick.

In the six following plates a series of illustrations of the British fossil *Echinidæ* is commenced, of the majority of which, even the commonest and those most important for the identification of strata, no good representations are accessible to the student of English fossils. The importance of a knowledge of the members of this family to the explorers of oolitic and cretaceous strata cannot be too strongly insisted on, and their beauty and interest, in a purely Natural History point of view, render them admirable subjects for elaborate delineations.

When the collections accumulated during the course of the progress of the Geological Survey have been thoroughly examined and arranged, new light may be expected, bearing on the details of structure of the species now figured. Additions will consequently be made to the plates from time to time; and it is proposed to issue supplementary figures of the variations of form exhibited by the several species selected as subjects for these decades.

EDWARD FORBES.

May, 1849.

BRITISH FOSSILS.

DECADE I. PLATE VII.

GALERITES (DISCOIDEA) SUBUCULUS.

[Genus GALERITES. LAMARCK. (Sub-kingdom Radiata. Class Echinodermata. Order Echinidæ. Family Cassidulidæ.) Body more or less hemispherical, always tumid; ambulacra simple, continuous, radiant; mouth central, inferior; anus inferior or submarginal; tubercles perforate.]

[Sub-genus *Discoidea*. Body hemispheric, circular, flat-based; tubercles in regular series; inside strengthened by strong ribs.]

SYNONYMS. *Discoidea subuculus*, KLEIN, t. 14, f. 57 (copied in Enc. Meth., pl. 153, f. 14-17). *Echinites subuculus*, LESKE. ap. KLEIN, p. 171. *Echinus subuculus*, GMELIN, p. 3183. *Galerites rotularis*, LAMARCK, An. sans Vert. iii., p. 309. *Discoidea subuculus*, PARKINSON, vol. iii., p. 21, pl. II., fig. 7. *Galerites subuculus*, GOLDFUSS, p. 129, pl. 41, f. 2. *Discoidea subuculus*, BRONN, Lethæa, p. 615, t. 29, f. 29. *Discoidea rotularis*, GRAY, Ann. Phil., 1825; AGASSIZ, Prod., p. 186. *Discoidea subuculus*, DESOR, Mon. Gal., p. 54; AGASSIZ and DESOR, Cat. Rais. des Echin. Ann. Sc. Nat., 3rd Ser., t. 7, p. 146. *Galerites (Discoidea) subuculus*, ROEMER, Nord Deutsch. Kreide Geb., p. 31; MÜLLER, Ach. Kreideformation, p. 8.

DIAGNOSIS. *G. (Discoidea) parva, hemisphærica, plus minusve convexa, marginibus rotundatis, ventre plus minusve excavato; areis ambulacralibus centro-lateralibus dimidium arearum interambulacralium adæquantibus; ano magno; assulis ambulacralibus 4 ad assulam interambulacralem.*

VAR. α. *Ambitu orbiculari, marginibus compressiusculis.—D. subuculus auctorum.* Loc., in arenâ viridi.

VAR. β. *Ambitu subpentagonali, marginibus rotundatis.—D. infera,* DESOR, Cat. Rais., p. 147? Loc., in cretâ albâ.

A wretched figure in Plott's "History of Oxfordshire," (1677, p. 140, pl. 8, f. 9,) is supposed to be the first representation of this fossil. It is described by Plott, as a "Button-stone from Teynton, a mere production of nature, except we should take it for a new sort of echinite not yet discovered, which is wholly left to the reader's choice." Lister, in his book, "De Lapidibus Turbinatis," copies it as an echinite. Klein quotes the same figure for his *Discoidea subuculus*, and gives figures himself (t. 14, f. 57) sufficiently recognisable. It is the type of the genus *Discoidea* of Klein, separated by that author from his genus

Conulus, of which *Galerites albogalerus* is the type. Leske, in his edition of Klein (p. 171), reunites the genera, and describes the species in detail. He remarks, however, that the figure of Plott is too doubtful to be quoted as a representation of the *Echinites subuculus*, and that it seems rather to represent a madrepore. He exercises more critical judgment in the examination of his references than is shown by some of his successors; who, indeed, whilst quoting him, do not appear to have read his text. He rejects, also, a figure in Langius, whose work I have not been able to see. Since then it has been figured, seldom very well, by Alexander Brogniart, from French specimens, by Goldfuss and Bronn from German examples, and by Parkinson (badly) from English ones. The latest and best representation is that given in the "Monograph of *Galerites*," by Desor.

Description.—The body exhibits an outline exactly orbicular, or occasionally exhibiting a very slight tendency to a pentangular contour. It is regularly convex above, but to a greater or less degree in different specimens, exhibiting every gradation of variation, from prominently conical to subdepressed. The upper surface is divided into five broad and five narrow segments, by the avenues of pores, which regularly radiate from the ovarian circle crowning the summit. The under surface is more or less flattened, with more or less rounded margins, and a more or less concave centre, in the middle of which is the circular mouth, and between the mouth and the posterior margin a large oblong anus.

The interambulacral segments are, in their widest part, rather more than twice the breadth of the ambulacra. The plates composing their dorsal portion rarely exceed 13 in number in full-grown specimens, of whatsoever shape. The central ones are broader than long; those near the summit more and more nearly of equal dimensions in both directions: but whatever be their horizontal diameter, their vertical measure is nearly the same in all. Their surfaces are thickly studded with minute secondary granules, more or less regularly arranged, often appearing as if placed in horizontal series. Each plate exhibits a more or less distinct subcentral carination, so that in many specimens the interambulacral spaces appear as if partitioned by two diverging keels, one on each side of the line of junction of the interambulacral plates. In the line of carination each plate bears a prominent primary tubercle, and in an horizontal row with it, towards the interambulacral suture, are two or three others similar in size and shape; whilst on the other division of the plate, towards the avenue, two or more similar tubercles are also seen, placed in two oblique series with reference to the position of the tubercle on the carina. Consequently, on the avenue side of each carina, in the interambulacral spaces, the tubercles appear as if

arranged in ascending oblique rows; and, on the centro-sutural side, in horizontal rows. Towards the margin the tubercles become more numerous, and sometimes less regularly disposed. The plates of the ventral surface are of equal vertical dimensions with those of the dorsal, and similarly ornamented. In well-grown specimens they are from six to eight in number. The suture of articulation of the interambulacral plates with each other varies in degree of straightness, or zigzag, in different specimens; and is most nearly straight when the dorsal surface is least depressed.

The ambulacral plates are very numerous and narrow, four of them going to the vertical diameter of an interambulacral plate. They are closely studded with granules like the latter, and each bears usually one primary tubercle. These tubercles are so arranged that they do not fall in direct vertical rows, but form oblique series of threes, or, as in some specimens, where alternate plates have their primary tubercles suppressed, in twos. On the ventral surface the tubercles are similar, except that they are often larger than those on the dorsal. Each plate corresponds to a pair of pores in the ambulacral avenue. The avenues are impressed, quite straight, and have the pairs of pores in regular succession, single file. They have a tendency to become obsolete near the mouth. The two pores of each pair are obliquely set with respect to each other. As there are about 21 interambulacral plates in each vertical series, from mouth to apex, in an ordinary specimen, the number of ambulacral plates will be about 84, and that of pairs of pores the same. The primary tubercles are placed on elevations in areolated spaces, and are invariably perforate.

The mouth is circular, and occupies the centre of the more or less concave ventral surface. Its breadth is rather less than the distance from its side to the outer margin. The anus occupies a considerable part of the ventral space between the two postero-lateral ambulacra and the margin. It is of an ovate form, its greatest dimensions being in the line of length, *i. e.*, from the mouth towards the margin, and its outer extremity is slightly pointed.

The apex is composed of the combined ovarian and ocular plates, and is in great part occupied by a madreporiform tubercle. The posterior ovarian pore is undeveloped, as in all the genus. The ocular pores are distinct.

Casts of the interior differ from the external shape of the body in exhibiting ten deep notches around the margin, extending to the mouth on the ventral surface, and ceasing at about a third of the height on the dorsal. Five of these unite near the mouth, and five continue singly to it. The centre of the prominent interspaces of the latter is marked by a shallow groove. The groove corresponds to the line of suture of the

ambulacral plates, and its prominent sides to the avenues of pores. The ten deep notches are caused by as many internal ribs, which spring from the inner sides of the mouth, and run up the wall under the carinated portion of each series of interambulacral plates.

Dimensions and Varieties.—The ordinary breadth of this species is about 7-12ths of an inch. The proportions of the breadth to the height are very variable, even in specimens from the same locality, as may be exemplified by the following instances of upper green-sand specimens from Warminster: 1st specimen, breadth to height (in millimetres,) 14 : 10 ; 2nd, 14 : 8 ; 3rd, 12 : 8 ; 4th, 11 : 9 ; 5th, 10 : 8. This variation in degree of elevation is accompanied by very great variation in rotundity of margin and convexity of base. The most rounded specimens are those of a variety which occur in the white chalk. It combines rotundity with height, and has usually fewer primary tubercles than are seen in ordinary specimens. In no essential respect, however, does it differ from the green-sand form, and may be paralleled exactly by exceptional specimens of the latter.

In the "Monograph of Galerites," by Desor, and in the "Catalogue Raisonné des Echinides," four species of *Discoidea* allied to *subuculus*, are enumerated. The first of these, *Discoidea minima* (Agassiz), founded on a single example from the chalk marl of France, seems, judging from figure and description, to be only one of the less conical forms of the young of the species, such as not uncommonly occur at Warminster. The second, *Discoidea pisum* (Merian), unfigured, is said to be exactly like *D. minima*, and only distinguishable from it and *subuculus* by having distinctly perforate primary tubercles. This, however, is the case with well-preserved specimens of every *Discoidea*, and is a generic, not specific, distinction. The third, *Discoidea turrita* (Desor), described and figured from a single example, is represented as proportionally higher than *subuculus*, and differing in having several vertical series of primary tubercles equally prominent on the interambulacral spaces, and not two only, like those on the keels. But we find in British specimens these characters combined or not, and occurring in individuals not uncommonly, besides exhibiting every degree of transition into the ordinary features of the species. The fourth is merely named in the "Catalogue Raisonné;" it is the *Discoidea infera* (Desor), from the white chalk of Fécamp, said to be very near *subuculus*, but differing in having the primary tubercles conspicuous only on the ventral surface. Specimens of our variety from the white chalk—the most distinct looking form of all—yet certainly not essentially so, accord very well with the brief and insufficient notice given in the catalogue.

Allied Species.—Although I have little doubt that the several so-

called species just mentioned are only slight varieties, if as much, of *subuculus*, there is, however, a white chalk *Galerites*, of the section *Discoidea*, in the cabinet of Mr. Dixon, of Worthing, and figured by that gentleman in his forthcoming work on the geology of Sussex, which, whilst very closely allied to the species here described, presents certain characters which are not present either in green-sand specimens of *subuculus*, or in those from the white chalk itself. In form and size it resembles ordinary examples of that species, and the proportion of the ambulacral to the number of interambulacral plates is the same, nor does the granulation of the surface materially differ. The proportions of mouth and anus, and their dimensions, as compared with the entire ventral surface, are so very different, and characters founded on such differences appear to be so constant in this genus, that I feel bound to regard it as distinct. The mouth, instead of being (as in *subuculus*) nearly equal in diameter to the distances between its sides and the margin of the inferior surface, is scarcely half that size, and the anus, instead of occupying the greater part of the space between the mouth and the margin, fills less than a half of it; consequently the appearance of the base, with its perforations, is materially different, and as I can find no specimens presenting intermediate characters among those of the *subuculus*, either from green sand or chalk, I feel bound to consider this a distinct species, and have named it *Galerites (Discoidea) Dixoni*.

In the preceding account of *Galerites subuculus*, and in my notes on *Galerites subcylindrica* (Dec. i., pl. viii.) I have considered the *Galerites rotula* of Alexander Brongniart (Geognosie des Terrains de Paris, pl. 9, f. 13, A. B. C.) as identical with the former species, and his figure as a representation of a large specimen of it. I am induced to do so on account of the evident manner in which the subcarination of the halves of the interambulacral spaces are indicated in his figure (13 A.), whilst the inferior surface is represented as thickly covered with nearly equal tubercles. Unfortunately no figure of the anus is given, to enable us to decide with more certainty. On one of the figures an appearance as if of a supramarginal anus is indicated, and this no doubt has led M. Charles Des Moulins to regard it as a *Pyrina*, and to name it *Pyrina rotula*. If his view of its characters be correct, it has certainly nothing to do with the section *Discoidea*. Agassiz has, however, considered Brongniart's figure as the type of his *Discoidea rotula*—a very different species, and which, since our note of *Galerites cylindricus* was put in type, I am still more inclined to identify with the *Discoidea* there described, from the junction beds of the chalk and green sand, and of which Mr. Morris has afforded me opportunities of seeing a number of specimens, of different ages, from Charlton, in Dorsetshire. An examination of them, and of their casts, confirms me in my opinion of the

propriety of uniting *Discoidea rotula* of Agassiz, and *Discoidea favrina* of Desor, since the character of the notching on the casts varies in different specimens. *Discoidea conica*, of Desor, I take to be the same species, assuming a more pentagonal form, a variety apparently not uncommon among British examples. The *Discoidea rotula* of Mr. M'Coy, from the upper chalk, must surely be something quite distinct. The young of the species, to which I would reserve the name *Galerites* (*Discoidea*) *favrinus*, might be confounded at first sight with *subuculus*, but is very different on close examination. It presents an orbicular outline, with a strong tendency to become pentagonal. It is regularly convex above, with more swelling sides, and, consequently, a flatter summit than *subuculus* has, whilst its margins are often nearly as much rounded as in that species. The interambulacral segments are, in their widest part, thrice the breadth of the ambulacra, and the ambulacra widely diverge from each other when proceeding from the summit, characters which will at once distinguish between this form in its young state and *subuculus*.

Locality and Geological Position.—It abounds in the UPPER GREEN SAND of Warminster, Chute Farm, Wilts; in the junction bed of GREEN SAND and CHALK MARL at Maiden Bradley, Wilts. (Survey Collections.) LOWER CHALK, Weymouth (Morris). In the WHITE CHALK of Kent, but not so common. Morris (Cat. p. 52) mentions its occurrence in the LOWER GREEN SAND of Hythe, Kent.

Foreign Distribution.—On the Continent it occurs in the chalk marl of France and Germany. Hillsconglomerat of Essen (Müller).

EXPLANATION OF THE PLATE.

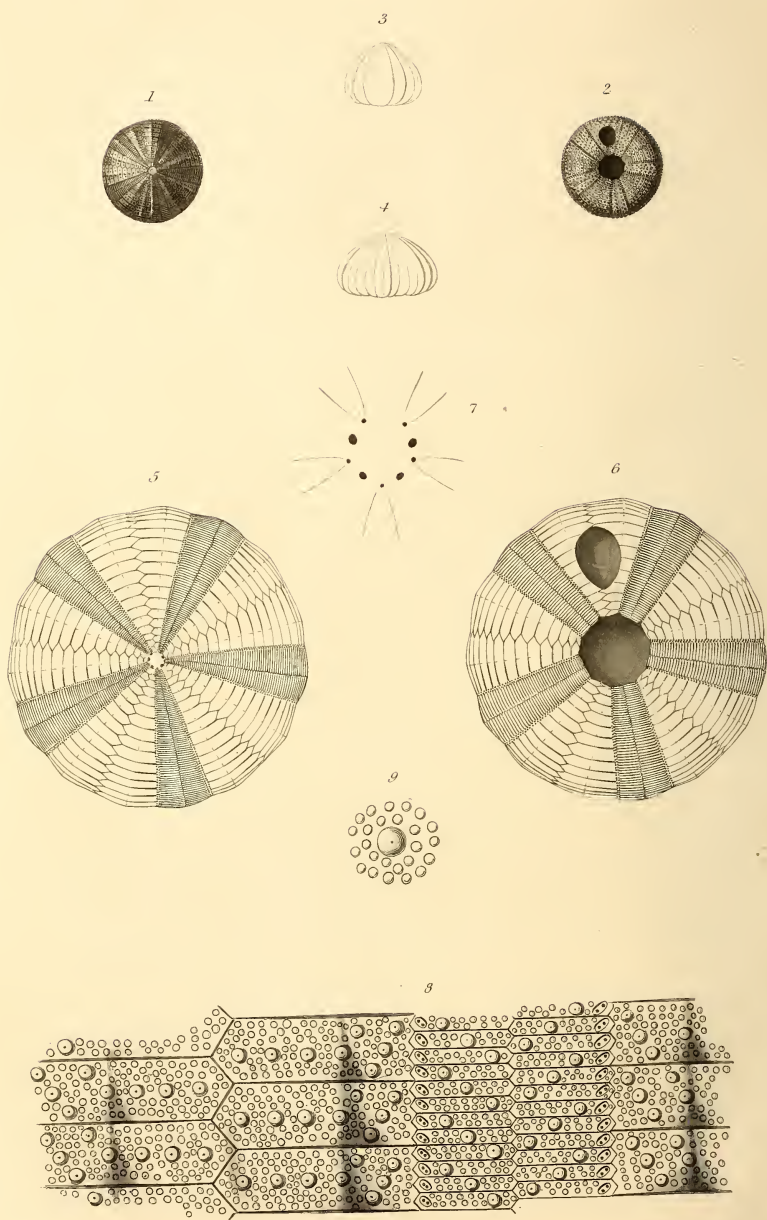
Figs. 1 and 2. Upper and under views of a green-sand specimen. Fig. 3. Profile of a conical green-sand specimen allied to var. β . Fig. 4. Sub-depressed variety. Figs. 5, 6. Magnified representations of the dorsal and ventral surfaces, showing the arrangements of the plates. Fig. 7. Arrangement of the ovarian and ocular pores on the summit. Fig. 8. Ambulacral and interambulacral plates, with their tubercles, granules, and pores. Fig. 9. Primary tubercle surrounded by granules.

April, 1849.

E. FORBES.

Geological Survey of the United Kingdom.

GALERITES
(Cretaceous)



GALERITES (DISCOIDEA) SUBUCULUS — Leske.